route 66

4.7) indeterminate form

$\infty - \infty$

L'Hôpital

ex:

$$\lim_{x \to \frac{\pi}{2}^-} \sec x - \tan x$$

$$= \lim_{x \to \frac{\pi}{2}^-} \frac{1}{\cos x} - \frac{\sin x}{\cos x}$$

$$= \lim_{x \to \frac{\pi}{2}^-} \frac{1 - \sin x \to 0}{\cos x \to 0}$$

$$\overset{LH}{=} \lim_{x \to \frac{\pi}{2}^-} \frac{-\cos x \to 0}{-\sin x \to -1} = \frac{0}{-1} = 0$$

$\boxed{\text{The idea around } \infty - \infty \text{ is to find a common denominator}}$

After that, check that L'Hospital's Rule apply, and use it

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(24) $\lim_{x\to 0} \frac{\sin^2 3x}{x^2} =$ $\sin^2 3x \to 0$, $x^2 \to 0$

$\sin^2(3x) = [\sin(3x)]^2$

$\overset{LH}{=} \lim_{x\to 0} \frac{2(\sin(3x)) \cdot \frac{d}{dx}(\sin(3x)) \left[\cdot \frac{d}{dx}(3x)\right]}{2x}$ later

$= \lim_{x\to 0} \frac{2\sin(3x)\cdot\cos(3x)\cdot 3}{2x}$

$\overset{LH}{=} \lim_{x\to 0} \frac{6[\cos(3x)\cdot\cos(3x)\cdot 3 + \sin(3x)(-\sin 3x)\cdot 3]}{2}$

$= \lim_{x\to 0} \frac{18(\cos^2(3x) - \sin^2(3x))}{2}$

$= \frac{18}{2} = 9$

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$$\lim_{x \to \frac{\pi}{2}^-} \frac{\tan x}{\frac{3}{2x-\pi}} \quad \begin{matrix} \to \infty \\ \to \infty \end{matrix}$$

$$\overset{LH}{=} \lim_{x \to \frac{\pi}{2}^-} \frac{\sec^2 x}{\frac{-3}{(2x-\pi)^2} \cdot 2} = \lim_{x \to \frac{\pi}{2}^-} \frac{\overset{\infty}{\sec^2 x}\ \overset{0}{(2x-\pi)^2}}{-6}$$

$$= \lim_{x \to \frac{\pi}{2}^-} \frac{(2x-\pi)^2}{(\cos x)^2(-6)}$$

LoL - going back

$$\lim_{x \to \frac{\pi}{2}^-} \frac{\tan x}{\frac{3}{2x-\pi}}$$

$$= \lim_{x \to \frac{\pi}{2}^-} \frac{\sin x}{\cos x} \cdot \frac{(2x-\pi)}{3}$$

$$= \lim_{x \to \frac{\pi}{2}^-} \frac{\sin(x)(2x-\pi)}{3\cos(x)} \overset{LH}{=} \lim_{x \to \frac{\pi}{2}^-} \frac{(\cos x)(2x-\pi)+(\sin x)(2)}{-3(\sin x)}$$

$$= \frac{2}{-3}$$

route 66

4.5/31 $V = \frac{4}{3}\pi r^3$

$\frac{dV}{dr} = 4\pi r^2$ approximate CHANGE in volume from $r=5$ ft to $r=5.1$ ft

$V(5)+V'(5)(x-5)$

approximate new volume $= \frac{500}{3}\pi + 100\pi(x-5)$

approximate change in volume $=$ new volume $-$ old volume

$$= \underbrace{\left[\frac{500}{3}\pi + 100\pi(5.1-5)\right]}_{\approx V(5.1)} - \underbrace{\left[\frac{500}{3}\pi\right]}_{=V(5)}$$

$\underbrace{\Delta y}_{\text{change in actual function}} \approx f'(a)(x-a)$

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